

Smoking in Small Places Separation Is the Only Solution

Increased smoking rates in many European countries bring with them a growing concern about indoor air quality. Without question, sidestream environmental tobacco smoke (sETS) from the tip of a burning cigarette immediately impacts the senses and causes discomfort; at the same time, perceptual and comfort aspects are growing in importance among indoor air quality regulators. Yet quantitative thresholds for odor and eye, nose, and throat irritation from sETS have not been conclusively determined.

New research by Martin H. Junker and colleagues from the Federal Institute of Technology in Zürich, Switzerland, indicates that odor thresholds for sidestream smoke and thresholds for eye, nose, and throat irritation are much lower than previously reported—300 times lower for odor thresholds and about 10 times lower for nasal and eye irritation [*EHP* 109:1045–1052]. Notably, the highest concentration of sidestream smoke to which subjects were exposed was equivalent to one cigarette being smoked in a room with a volume of 100 cubic meters, the size of a spacious European living room. This study is the first controlled laboratory experiment to consider sensory symptoms at such low concentrations of sETS.

To measure the sensory impact of indoor secondhand smoke, investigators exposed 24 healthy female nonsmokers aged 18–35 to varying concentrations of sETS. The toxic components of sETS were continuously monitored, and included particle-bound polycyclic aromatic hydrocarbons, total volatile organic compounds, particle number concentrations, and carbon monoxide.

In an initial olfactory experiment, the researchers had 18 subjects place their noses into an olfactometer. When smoke from passively burning cigarettes was introduced in varying concentrations, subjects indicated when they were able to detect its presence.

In a second experiment, 24 subjects were seated in an exposure chamber into which varying concentrations of cigarette smoke were added to the airflow. At each concentration level, breathing patterns and startle reflexes were measured. At each level, subjects scaled their perceptions of odor strength; eye, nose, and throat irritation; arousal; annoyance; odor perception; and judgment of air quality. The investigators then plotted increases in the intensity of symptoms against relative increases in the concentration of smoke.

Results showed that even at the lowest sETS concentrations, the subjects perceived a significant increase in eye, nose, and throat irritation. They also felt considerably more annoyed, and the quality of air was reported to be less acceptable compared with air not polluted by sETS. At the highest sETS exposure, the startle reflex amplitude was reduced. The authors interpreted this finding as indicative of distracted attention.

The researchers found that to protect against eye and nasal irritations, the volume of fresh air needed to dilute the smoke from a single cigarette would be more than 3,000 cubic meters. To ensure acceptable indoor air quality, the sidestream smoke of one cigarette would have to be diluted by an estimated fresh air volume of 19,000 cubic meters. This is at least 100 times the volume other researchers have proposed.

The sensory thresholds are so low, the researchers observed, that protecting indoor air quality would require ventilation rates that are impractical and economically ruinous. They conclude that effectively protecting nonsmokers requires separately ventilated areas or a complete ban on smoking. —Laura Alderson

Antioxidant Antidote Staving Off Effects of Sidestream Smoke

Dietary antioxidants have long been promoted as a defense against many diseases, such as cancer, cardiovascular disease, and diseases of the immune system. A new study provides evidence that in animals, multiple antioxidants can help lessen the harmful effects of secondhand cigarette smoke, and they may lessen the effects of secondhand smoke in humans [*EHP* 109:1007–1009]. The study, by Jin Zhang and colleagues at the College of Public Health at the University of Arizona Health Science Center, explores for the first time certain cellular responses in aged mice to sidestream cigarette smoke (one component of secondhand smoke), and the effect of antioxidants in reducing these responses.

The researchers found that exposure to moderate levels of sidestream cigarette smoke increased harmful oxidation and also promoted the production of interleukin-6, an inflammatory mediator closely linked to cardiovascular disease. The study showed that multiple antioxidants given as dietary supplements prevented these changes. The 11 antioxidants fed to the mice in the study were beta-carotene, bioflavonoids, coenzyme Q10, D-alpha-tocopherol, L-ascorbic acid, L-carnitine, magnesium, N-acetylcysteine, retinol, selenium, and zinc.

Cigarette smoke does much of its damage via free radicals in the form of reactive oxygen species. These highly reactive oxygen molecules are believed to play an important role in the development of a wide range of diseases. Reactive oxygen species can overwhelm the cell's antioxidant defenses. They can also start the cellular chain reaction that leads to inflammation. Not only is tobacco smoke among the greatest external sources of free radicals, it also works internally, causing the body to produce reactive oxygen species that may increase damage inside cells.

From earlier research, the investigators hypothesized that multiple antioxidants, rather than a single one, may be required to prevent the damaging oxidation and proinflammatory response that sidestream smoke causes. To investigate whether moderate intake of sidestream smoke starts a proinflammatory response and promotes oxidative damage, the researchers looked at three cellular defense mechanisms—hepatic lipid peroxide production, vitamin E level, and interleukin-6 production—in both “nonsmoking” and “smoking” mice.



Smoking or nonsmoking? New research suggests that relegating smokers across a room may not be enough to mitigate the effects of sidestream smoke.

The mice used in the study were healthy and old (13 months of age at the start of the study). They were divided into four groups: nonsmoking mice fed or not fed multiple antioxidants, and smoking mice—exposed to a burning cigarette for 30 minutes a day, 5 days a week, for 4 months—either fed or not fed multiple antioxidants.

The researchers found increased production of interleukin-6 in the spleen and lipid peroxides in the liver in the smoking mice. Lipid peroxides result when a cell's antioxidant defenses are overwhelmed by reactive oxygen species. Interleukin-6 is a proinflammatory cytokine, produced as an immune response to inflammation. The study also found that in smoke-exposed mice, vitamin E, a powerful antioxidant, was depleted. This suggests that the cell antioxidant defense system is affected by sidestream cigarette smoke exposure.

Adding multiple antioxidants to the diet turned these effects around. For both smoking and nonsmoking mice fed antioxidant supplements, lipid peroxide production was significantly lower, while vitamin E levels were significantly higher. In addition, smoke-exposed mice fed antioxidant supplements showed significantly lower production of interleukin-6 compared to smoke-exposed mice on a control diet. The authors suggest that supplementing the diet with multiple antioxidants may reduce the effects of exposure to sidestream cigarette smoke in humans as well. —Laura Alderson

Pesticides Hit Home

Rating the Risks for Kids in California

Pesticides have long been suspected of causing childhood cancer, but establishing a cause-and-effect relationship is difficult. Children are exposed to unknown varieties and quantities of pesticides. Parents seldom know which compounds are being used in nearby agricultural fields. Epidemiologic studies often suffer from case-response bias: parents of sick children are more likely to remember using pesticides. And when cancer clusters are investigated, the cases are often too few to prove an association with pesticides.

Robert Gunier and colleagues at the California Department of Health Services describe a methodology to address these limitations [EHP 109:1071–1078]. The methodology compares pesticide use to location, and weights both hazard and usage to give an effective measure of the actual danger of the chemicals. Using data from California's Pesticide Use Report, a mandatory statewide pesticide-application reporting system begun in 1990, they determined which census block groups (subdivisions of census tracts) had received which pesticides from 1991 to 1994. To increase statistical power, they focused on the 38 most used insecticides, fungicides, and herbicides in the state and grouped the pesticides in four categories: genotoxicants, reproductive and developmental toxicants, probable carcinogens, and possible carcinogens (California has banned known human carcinogens from agricultural use). More than 36 million pounds of genotoxic active ingredients were used in California during the average year.

Pesticides were assigned a numerical hazard factor, based on toxicity and exposure factors:

- cancer class (probable or possible human carcinogen), determined by the U.S. Environmental Protection Agency;
- cancer potency, or how much the incidence of cancer increases with dose (usually determined by laboratory animal studies);
- volatilization flux rate, or how rapidly the compound enters the atmosphere (important because inhalation is a major exposure route); and
- field half-life, or how long the compound lingers in the field.

Among probable human carcinogens, the hazard factor varied by a factor of seven or eight between the least and most hazardous



Children and the corn. A new method of rating the hazards of agricultural pesticides to children may improve epidemiologic studies.

compounds. Among reproductive and genotoxic compounds, the maximum disparity was a factor of four. The hazard factor was multiplied by usage rates to find “hazard-adjusted use”—the overall hazard level for each pesticide. So, for example, while 1.6 million pounds of the insecticide propargite were actually used in the state, the compound's hazard factor of 1.4 gave it a hazard-adjusted use rating of 2.2 million pounds. On the other hand, the 2.4 million pounds of chlorpyrifos actually used had a hazard factor of .096, giving it a hazard-adjusted use rating of only about 233,000 pounds.

Pesticide use also varied widely by location. Seventy-seven percent of census block groups received less than 1 pound of active ingredient per square mile. But 493 block groups (home to about 170,000 children) received more than 569 pounds per square mile.

The study could not evaluate some widely used pesticides for which toxicologic data are lacking, and California's reporting system ignores home and garden pesticides. However, the hazard-adjusted use rating could help solve an old question in epidemiology: What is the connection between childhood cancer and pesticides? The researchers plan to use the results to compare childhood cancer rates in census block groups with intense use of hazardous pesticides to block groups without such use. —David J. Tenenbaum